DIRECT SEEDING VERSUS PLANTING FOR ESTABLISHMENT OF PINES ON WEST FLORIDA SANDHILLS [1/]

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Abstract.--Survival and growth of direct-seeded longleaf, slash, and Choctawhatchee sand pines were compared with that of nursery-grown 1-0 seedlings on a typical sandhills site. Nursery seedlings of all species grew faster initially, but by age 8 growth rates were similar for trees on both planted and seeded areas. Trees on the planted areas, however, are still significantly larger than those on seeded areas because of the advantage gained in the early years. Direct-seeded slash and longleaf pine plots are now understocked and, because of mortality from brown-spot needle blight, planted longleaf plots are also poorly stocked. Planted slash pine plots are fairly well-stocked but growth rates have been poor. Sand pine had the best rate of growth and was the only species successfully established by direct seeding.

INTRODUCTION

About 8 million acres of sandhills are scattered throughout the southeastern coastal plain of the United States. These marine deposits from the Pleistocene epoch are an important physiographic feature of central and northwest Florida. They also occupy significant areas of Georgia, South Carolina, and North Carolina in the transition zone between the upper coastal plain and the piedmont (Burns and Hebb 1972). Sandhills soils are typically acid, infertile, and droughty. Because of sorting action during deposition they are largely quartz sands, ranging from a few feet to more than 20 feet deep.

The sandhills were once dominated by relatively open stands of longleaf pine (Pinus palustris Mill.) but only scattered patches and isolated trees remain. Most sites were claimed by a scrub oak-wiregrass understory following removal of the longleaf in the early 1900's. This scrub vegetation is principally turkey (Quercus laevis Walt.), bluejack (Q. incana Bartr.), and sandpost (Q. stellata var. margaretta (Ashe) Sarg.) oaks, and wiregrass (Aristida stricta Michx.).

The Chipola Experimental Forest was established in northwest Florida by the USDA Forest Service in the early 1950's to develop methods for making sandhills more productive forest sites. Initial observations indicated that direct seeding might be used to establish pine plantations on these areas. Direct seeding is cheaper than planting nursery-grown seedlings. The objective of this study was to compare the survival and growth of direct-seeded longleaf, slash (P. elliottii Engelm.), and Choctawhatchee sand (P. clausa var. immuginata Ward) pines with nursery-grown 1-0 transplants on site-prepared scrub oak sandhills.

METHODS

Study Site

The study site is 1.3 miles west of the Chipola Experimental Forest headquarters (NW 1/4 of Sec. 5, T 1 S, R 10 W) in Calhoun County, Fla. The soil is a typical droughty, deep sand of the Lakeland series. The site was burned in May, chopped in July, and rechopped in August 1958. Plots established in 1963 were disked in November 1962; plots established in 1964 were disked in November 1963.

Experimental Design

A randomized block, split-plot design with treatments replicated over time included four blocks with 12 plots within each. Within each block, species were randomly assigned to a group of four plots, i.e., the main plots. These four

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plots were randomly selected for direct sowing or planting, two in 1963 and two in 1964. Plots were 16 by 200 feet and contained 50 seed spots or transplants, two rows of 25 each.

Establishment

Seeds were collected from natural stands of longleaf and slash pine on the Chipola Experimental Forest in the fall of 1960. Sand pine seeds were collected on the Eglin Air Force Reservation in the fall of 1961. Germination averaged about 70 percent in tests of all seed lots before and after study establishment.

A repellent coating of Arasan® and endrin was applied to direct-sowed seeds. Twelve seeds were sowed at each seed spot with spots at an 8- by 8-foot spacing. Seeds were covered with 1/4 to 3/8 inch of soil and a hardware mesh cone was placed over the seed spot for protection from predators. Some type of seed protection is necessary on small areas cleared in scrub oak sites but would not be required on larger operational-scale areas. One year after sowing, the cones were removed and all but the largest seedling was removed from spots with multiple seedlings.

Seedling stock was grown in the Chipola Experimental Forest Nursery. After 1 year in the nursery, seedlings were lifted and dibble planted in the field at an 8- by 8-foot spacing. Direct seeding and planting 1-0 stock was done in February for both the 1963 and 1964 plots. Fall or winter is the recommended season for direct sowing longleaf, slash, and sand pine in this area (Burns and McReynolds 1975), but a February date was used to coincide with the date seeds were sowed in the nursery for the planting stock.

Data Collection and Analysis

Heights and survival were recorded annually on all plots from ages 1 to 10 years. Tree diameters were measured on all plots at age 10. Heights and diameters were measured on the sand pine plots only at 20 years of age. Initial survival for direct-seeded plots was based on the 12 seeds planted at each seed spot. Survival data after 1 year were based on the number of planting or seed spots. Other than the initial survival of direct-sowed seedlings, there were no significant differences between the 1963 and 1964 plots so data were combined for analysis and presentation.

RESULTS AND DISCUSSION

Based on the 12 seeds planted at each seed spot, survival at the end of the first planting season was 19, 14, and 58 percent for longleaf, slash, and sand pine, respectively, for the 1963 planting, and 75, 69, and 79 percent, respectively, for the 1964 planting. The difference in initial survival was largely due to a dry period in March and April of 1963 when total rainfall for the 2-month period was less than 2 inches. Even though survival was low for direct-seeded plots in 1963, at least one seedling survived at each planting spot. Thus, all plots for both years were fully stocked after 1 year.

Between ages 1 and 10, mortality was rather high on the direct-seeded longleaf and slash pine plots, and both were understocked at age 10 (Table 1). Plots direct seeded to sand pine had an acceptable density of 325 trees per acre after 20 years. Plots planted to longleaf were understocked due to losses from brown-spot needle blight (Scirrhia acicola (Dearn.) Siggers). Planted slash and sand pine each had more than 80 percent survival after 10 years.

Table 1.-- Stocking and growth of direct-seeded and planted longleaf, slash, and sand pines on a west Florida sandhills site.

Establishment method	Stocking	Diameter[1/]	Height	Volume[2/]
	No./acre	Inches	Feet	Ft.^{3}/acre
LONGLEAF PINE (age 10)				
Direct seeded	210	1.7	3.3	8
Planted	245	2.5	6.2	30
SLASH PINE (age 10)				
Direct seeded	180	1.2	11.5	28
Planted	555	3.1	17.2	256
CHOCTAWHATCHEE SAND PINE (age 10)				
Direct seeded	350	3.1	18.1	220
Planted	630	4.7	24.5	1045
CHOCTAWHATCHLE SAND PINE (age 20)				
Direct seeded	325	5.4	42.6	1100
Planted	625	6.9	47.8	3450

[1/] All differences in growth attributed to method of establishment are statistically significant at the 0.05 level.

[2/] Volumes are for the entire bole inside bark. Longleaf and slash pine volumes are based on equations from Schmitt and Bower (1970).

During the early years of the study, planted stock grew at a faster rate than direct-seeded trees (Fig. 1). Since about age 8, however, height-growth rates have been nearly equal for both establishment methods. The initial advantage of the planted trees was still evident after 10 years, with planted sand pine averaging 6.4 feet taller, planted slash pine 5.7 feet taller, and planted longleaf pine 3.2 feet taller than the direct-seeded trees of the same species (Table 1). Average diameters at age 10

were also greater for the trees established by planting. These height and diameter advantages of the planted stock continued for sand pine through age 20.

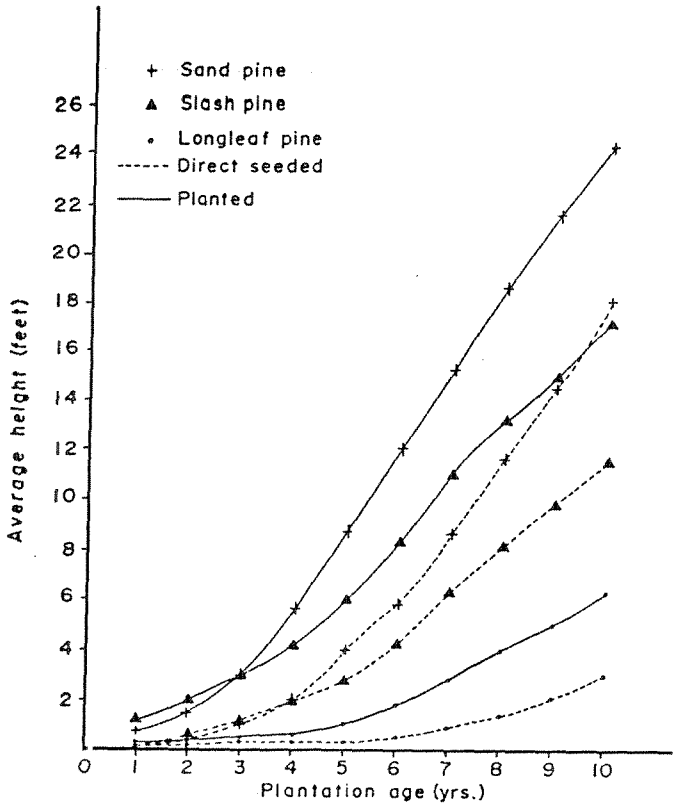

Figure 1.--Average tree heights by species, age, and establishment method.

Because of poor survival and lower growth rates, direct-seeded plots produced much less wood than the planted stands at 10 years of age (Table 1). Plots planted to longleaf and sand pine contained about four times as much wood as direct-seeded plots while planted slash pine plots contained nine times as much wood as direct-seeded plots. The difference in volume between direct-seeded and planted sand pine had diminished somewhat by age 20, but planted plots were still superior.

Some of the observed height advantage was because planted trees were 1 year older than direct-seeded trees. The height of direct-seeded trees, however, lagged 2 or more years behind the planted stock. Thus, planted trees had more than just an age advantage. Because of their initial height, planted trees were better able to deal with competing vegetation and suffered less growth loss. Because these sandhills sites tend to be infertile, some of the difference in growth was likely due to nutrients that the planted stock accumulated while in the nursery. Once both types of trees were above the competition and dilution effects had mediated the nutrient differences, an equalization in mean annual height growth would be expected. Sand pine height growth between ages 10 and 20 averaged 2.25 and 2.3 feet per year on direct-seeded and planted plots, respectively, while diameter growth was 0.23 and 0.22 inches per year. Thus, as expected, growth rates did equalize.

Even though all plots were fully stocked at the end of the first growing season, poor stocking at age 10 was a significant problem with the direct-seeded longleaf and slash pine plots. For longleaf pine this was primarily because of brown-spot disease, which could be controlled to reduce mortality. Seeding rates could also be adjusted to compensate for expected mortality. However, even when adequate stocking was obtained, as it was in the planted longleaf and slash pine plots, growth rates were still inferior to that of sand pine.

CONCLUSIONS

Choctawhatchee sand pine had the best growth in both direct-seeded and planted plots. This would be expected since Choctawhatchee sand pine has consistently outperformed all other species tested on these sandhills sites (Brendemuehl 1981). In addition, sand pine was the only tested species where adequately stocked stands were established by the direct-seeding method of regeneration. Even though successfully established by direct seeding, because of the limited seed supply and the slower initial growth compared with planted seedlings, planting in most cases would be preferred. The only advantage of direct seeding is lower establishment cost.

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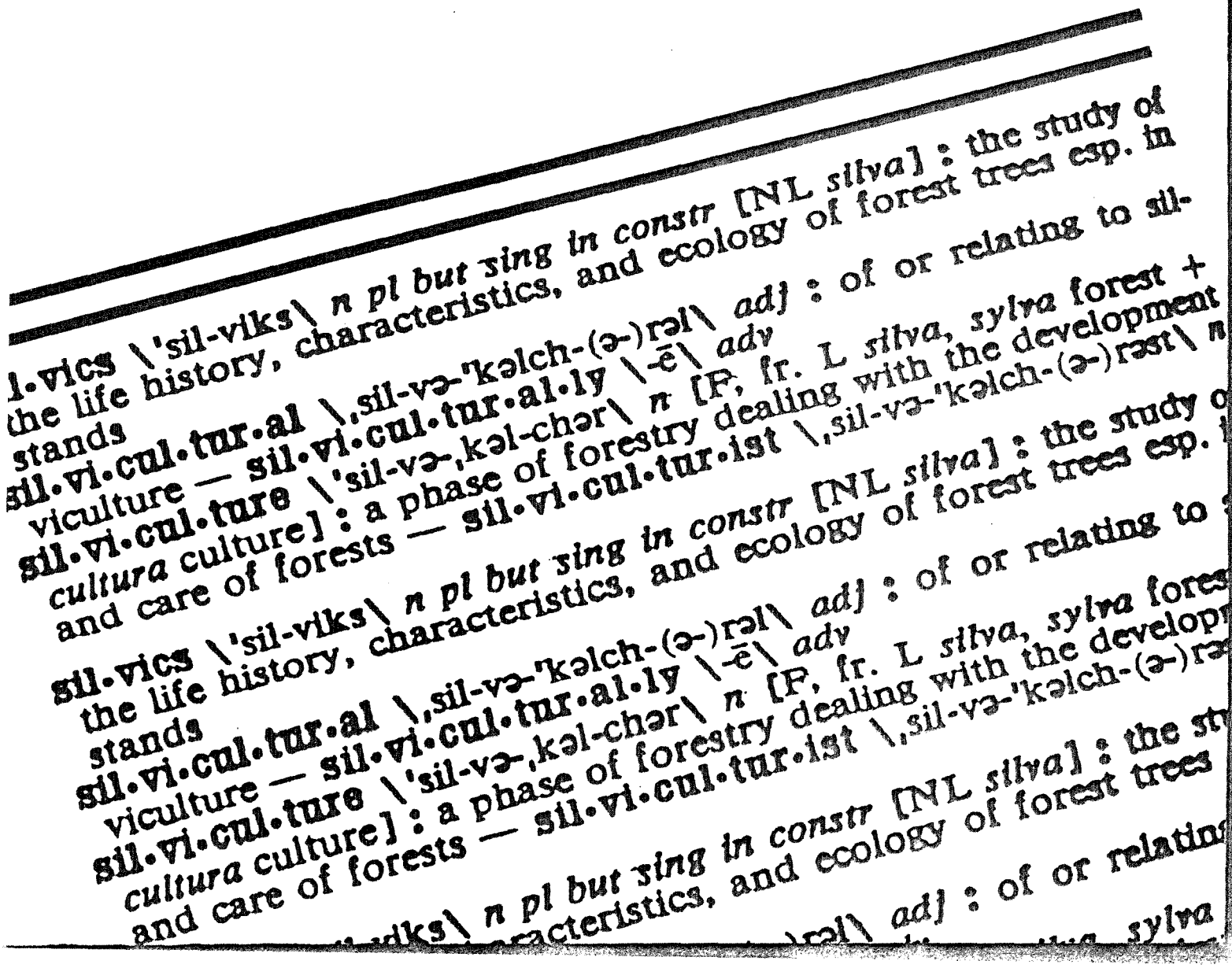

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